EECS 474: Probabilistic Graphical Models

Fall 2016

Introductions

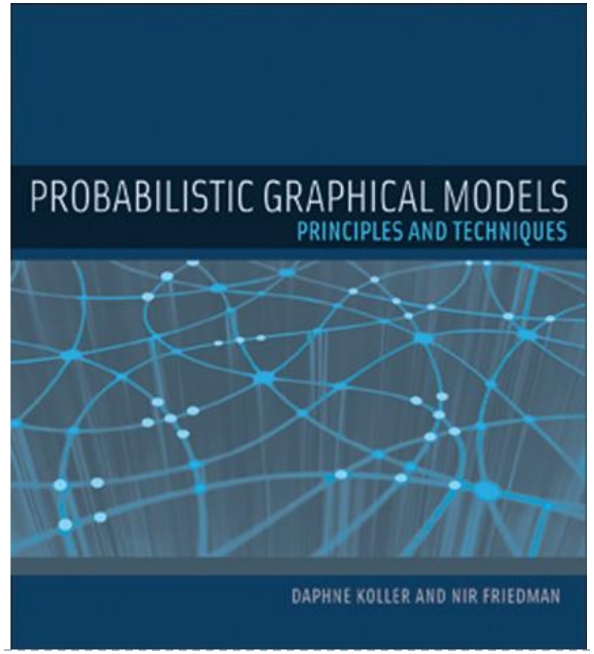
- Professor: Doug Downey
- Course web site:
  - www.cs.northwestern.edu/~ddowney/courses/474_Fall2016/
  - (linked off prof. home page very soon)

Logistics

- Grading
  - Homework (50%)
    - Handed out in weeks 1, 2, 4, 6, 8
    - Exercises and programming
  - Midterms (50%)
    - Weeks 5 & 9
    - A lot like the homework

Textbook

- D. Koller & N. Friedman,
  Probabilistic Graphical Models: Principles and Techniques
  MIT Press, 2009.

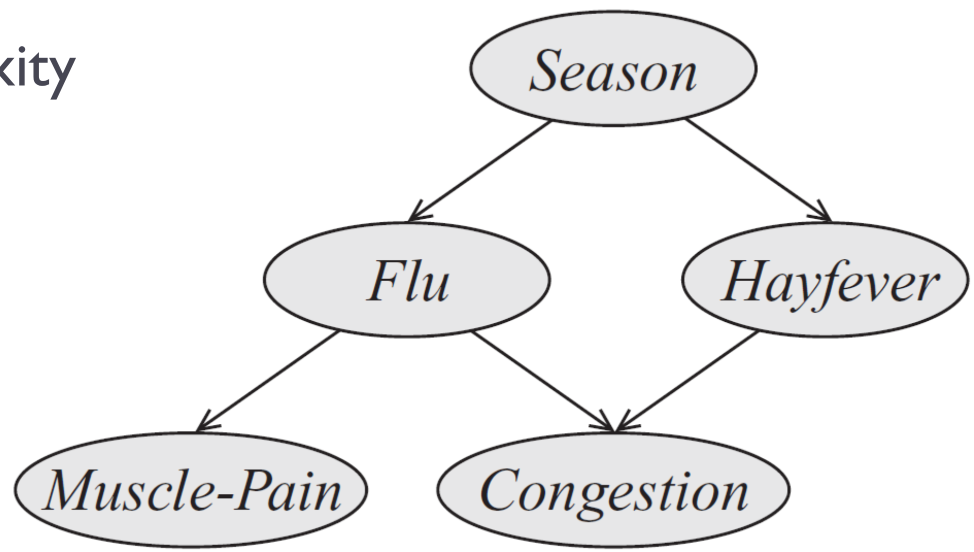


Motivation

- Artificial Intelligence
  - tremendous success in domains *without* a lot of uncertainty (e.g. chess)
  - But in the real world, uncertainty reigns
- We are awash in data
  - A crisis and an opportunity
- How can we deal with uncertainty? And how can we exploit massive bodies of data?

What the course is about

- **Probabilistic Models**
  - Deal with uncertainty: assign degree of confidence that different events will occur
- **Probabilistic Graphical Models**
  - Graph-based representation
  - *Compactly* encode complexity



Goals

- Learn how to:
  - Build probabilistic models from data
  - Use the models to do work
  - Recognize opportunities for using models

Compared to Other Courses (1 of 2)

- EECS 349 is a prerequisite for this class

EECS 349	This class
Studies methods for learning ***functions***	Studies methods for learning ***distributions***
More ***algorithmic***	More ***mathematical***
Surveys ***many*** approaches	Dives deep into a ***few*** approaches

Compared to Other Courses (2 of 2)

- Statistics vs. this class
  - A few variables vs. tens of thousands
  - Continuous vs. discrete variables
  - Our focus: computational issues and applications
    - How can we scale to huge, multivariate data sets?
    - When and where are graphical models useful?

Applications

- Almost anything!
- E.g.,
  - Computational Biology
  - Robotics
  - Vision
  - Human-Computer Interaction
  - Networks and Systems
  - Information Retrieval/Web Search
  - Etc., etc.

Topics

- Basics of Probability and Statistical Estimation (briefly)
- Representing Probability Distributions as Graphs
  - Directed (“Bayes Nets”) and Undirected (“Markov Nets”)
- Working with Probabilistic Graphical Models
  - **Inference**: making predictions with a model
  - **Learning**: acquiring models from data
- Restricted Boltzmann Machines (a “deep network”)
- Statistical Language Models: Hidden Markov Models, Recurrent Neural Networks, Long Short-term Memory Networks